

## 5.4 VOLCANIC HAZARDS

A major volcanic hazard event has been determined to have a **Low** likelihood of occurrence in Benton County within the five-year planning cycle of this Plan. Therefore, although some hazard characterization information is presented below, no further risk assessment has been performed for volcanic hazards. Additional analyses to further characterize the risks of this hazard and the development of suitable mitigation action items will be conducted in the future based on periodic reviews of this hazard mitigation plan and available resources

### 5.4.1 Nature of the Hazard

The Pacific Northwest is part of the “Ring of Fire,” an area of active volcanic activity surrounding the Pacific Ocean. Volcanic eruptions occur along the Ring of Fire, in part, because of the movement of the Earth’s tectonic plates. The Earth’s outermost shell, the lithosphere, is broken into a series of slabs known as tectonic plates. These plates are rigid, but they float on a hotter, softer layer in the Earth’s mantle. As the plates move about on the layer beneath them, they spread apart, collide, or slide past each other. Volcanoes occur most frequently at the boundaries of these plates and volcanic eruptions occur when the hotter, molten material, or magma, rises to the surface.

### Historical Events

Benton County has been impacted by volcanic ashfall from the eruption of several volcanoes in the Cascade Range of Washington and Oregon over the last 15,000 years (Table 5.4-1).

**Table 5.4-1. Historic Volcanic Eruptions and Their Effect in Benton County**

Volcano	Eruption	Distance from Vent	Effect in Benton County
Glacier Peak, WA	14,500 yr B.P.	110-170 miles	~0.2 inches ash
Glacier Peak, WA	11,000-12,000 yr B.P.	110-170 miles	~5-6.7 inches ash
Mt. Mazama (Crater Lake), OR	6,800 yr B.P.	220-285 miles	~14-15 inches ash
Mt. St. Helens, WA	3,300-4,000 yr B.P.	120-155 miles	~4.3-5.5 inches ash
Mt. St. Helens, WA	May 18, 1980	120-155 miles	0-5 mm ash (0-0.2 inches)

Eruption dates are years before present (B.P.); ash thickness estimates are uncompacted original thickness. Source: USGS Fact Sheet 027-00, Hoblitt and others (1987), and Sarna-Wojcicki and others (1981).

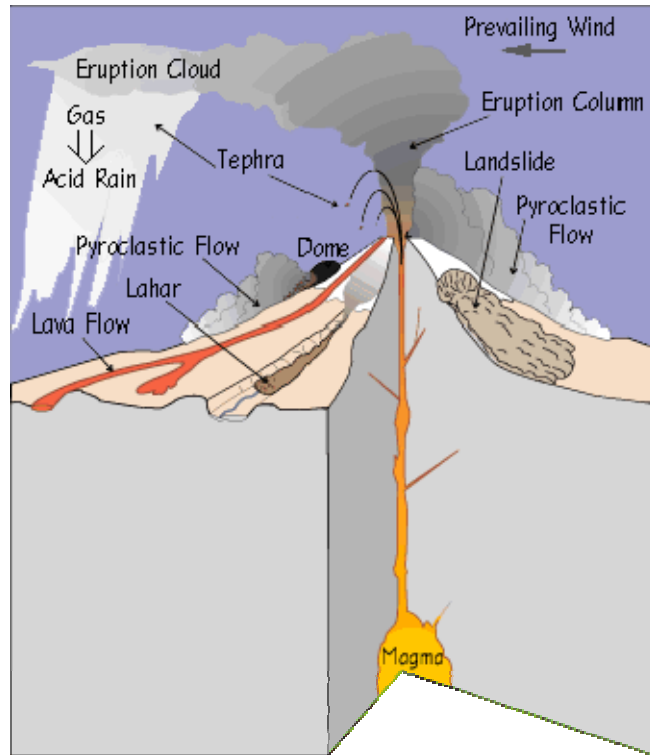
The most recent volcanic ashfall in the County was from the May 18, 1980 eruption of Mt. St. Helens. A few minutes after the start of the eruption at 0832 PDT on May 18, a vertical column of hot, ash-charged gas shot vertically from the volcano and grew rapidly to altitudes of over 80,000 ft. The ash plume then traveled to the east-northeast within a high-velocity wind layer at altitudes of 35,000-45,000 ft at an average velocity of about 60 miles/hr for the first 620 miles. Within 90 minutes the ash plume had reached Benton County. As the plume drifted overhead a rain of ash began to fall, turning the day into darkness. The southern edge of the ash plume crossed Benton County resulting in a total ash accumulation of zero in the southern part of the county to 5 mm (0.2 inches) in the northern part of the county. Because of the prevailing wind that day, the ash plume axis was located north of the county. At the same distance from the vent

as Benton County, areas along the ash plume axis received about 2-4 cm (~0.8-1.6 inches) of ash accumulation (Sarna-Wojcicki and others, 1981).

There are no reports of significant impacts due to volcanic gases from previous volcanic eruptions in the Cascade Range (USGS Volcano Hazards Program).

### **Volcanic Hazard Characteristics**

**Figure 5.4-1. Types of Volcanic Hazards**



Source: USGS Volcano Hazards Program

Volcanic hazards include lahars, landslides, lava flows, pyroclastic flows, volcanic gases and tephra (Figure 5.4-1). Lahars (mudflows or debris flows), volcanically induced landslides, lava flows, and pyroclastic flows (high-density mixtures of hot, dry rock fragments and hot gases that move at high speeds away from the vent that erupted them) are limited to the near proximity of a volcano (several tens of miles) or river valleys downstream of a volcano. Because Benton County is located over 75 miles east of the nearest volcano, the only credible volcanic hazards are from volcanic gases and tephra from future eruptions in the Cascade Range of Washington and Oregon.

Tephra is a general term for fragments of volcanic rock and lava regardless of size that are blasted into the air by explosions or carried upward by hot gases in eruption columns or lava fountains. Such fragments range in size from less

than 2 mm (0.08 in.; called ash) to more than 1 m (3.3 ft) in diameter. Large-sized tephra typically falls back to the ground on or close to the volcano and progressively smaller fragments are carried away from the vent by wind. Volcanic ash, the smallest tephra fragments, can travel hundreds to thousands of miles downwind from a volcano. Unfortunately, the size of ash particles that fall to the ground and the thickness of ashfall downwind from an erupting volcano are difficult to predict in advance. Not only is there a wide range in the size of an eruption that might occur and the amount of tephra injected into the atmosphere, but also the direction and strength of the prevailing wind can vary widely.

Volcanic ash is highly disruptive to economic activity because it covers just about everything, infiltrates most openings, and is highly abrasive. Airborne ash can obscure sunlight to cause temporary darkness and reduce visibility to zero. Ash is slippery, especially when wet; roads, highways, and airport runways may become impassable. Automobile and jet engines may stall from ash-clogged air filters and moving parts can be damaged from abrasion, including bearings, brakes, and transmissions.

Magma contains dissolved gases that are released into the atmosphere during volcanic eruptions. Together with tephra and entrained air, volcanic gases can rise tens of miles into Earth's atmosphere during large explosive eruptions. Once airborne, the prevailing winds may blow the eruption cloud hundreds to thousands of miles from a volcano. The gases spread from an erupting vent primarily as acid aerosols (tiny acid droplets), compounds attached to tephra particles, and microscopic salt particles. The most abundant gas typically released into the atmosphere from volcanic systems is water vapor ( $\text{H}_2\text{O}$ ), followed by carbon dioxide ( $\text{CO}_2$ ) and sulfur dioxide ( $\text{SO}_2$ ). Volcanoes also release smaller amounts of other gases, including hydrogen sulfide ( $\text{H}_2\text{S}$ ), hydrogen ( $\text{H}_2$ ), carbon monoxide ( $\text{CO}$ ), hydrogen chloride ( $\text{HCl}$ ), hydrogen fluoride ( $\text{HF}$ ), and helium ( $\text{He}$ ). The volcanic gases that pose the greatest potential hazard to people, animals, agriculture, and property are sulfur dioxide, carbon dioxide, and hydrogen fluoride. Locally, sulfur dioxide gas can lead to acid rain and air pollution downwind from a volcano. Because carbon dioxide gas is heavier than air, the gas may flow into low-lying areas and collect in the soil. The concentration of carbon dioxide gas in these areas can be lethal to people, animals, and vegetation. A few historic eruptions have released sufficient fluorine-compounds to deform or kill animals that grazed on vegetation coated with volcanic ash; fluorine compounds tend to become concentrated on fine-grained ash particles, which can be ingested by animals.

### **5.4.2 Hazard Assessment**

#### **Hazard Identification**

A volcanic eruption in the Cascade Range could impact Benton County with volcanic ash fall if the wind is blowing in the prevailing easterly direction. However, any volcanic eruption in the Cascade Range that affects regional infrastructure, air traffic, bridges, or Interstates 90, 84, or 82 will have both direct and indirect impacts on the county.

When volcanic ash accumulates on buildings, its weight can cause roofs to collapse, killing and injuring people. A dry layer of ash 4 inches thick weighs 120 to 200 pounds per square yard, and wet ash can weigh twice as much. The load of ash that different roofs can withstand before collapsing varies greatly - flat roofs are more likely to collapse than steeply pitched ones.

Because wet ash conducts electricity, it can cause short circuits and failure of electronic components, especially high-voltage circuits and transformers. Power outages are common in ash-fall areas, making backup power systems important for critical facilities, such as hospitals.

Eruption clouds and ash fall commonly interrupt or prevent telephone and radio communications in several ways, including physical damage to equipment, frequent lightning (electrical discharges), and either scattering or absorption of radio signals by the heated and electrically charged ash particles.

Volcanic ash can cause internal-combustion engines to stall by clogging air filters and also damage the moving parts of vehicles and machinery, including bearings and gears. Engines of jet aircraft have suddenly failed after flying through clouds of even thinly dispersed ash. Roads, highways, and airport runways can be made treacherous or impassable because ash is slippery and may reduce visibility to near zero. Cars driving faster than 5 miles per hour on ash-covered roads stir up thick clouds of ash, reducing visibility and causing accidents.

Ash also clogs filters used in air-ventilation systems to the point that airflow often stops completely, causing equipment to overheat. Such filters may even collapse from the added weight of ash, allowing ash to invade buildings and damage computers and other equipment cooled by circulating outside air.

Agriculture can also be affected by volcanic ash fall. Crop damage can range from negligible to severe, depending on the thickness of ash, type and maturity of plants, and timing of subsequent rainfall. For farm animals, especially grazing livestock, ash fall can lead to health effects, including dehydration, starvation, and poisoning.

Like airborne particles from dust storms, forest fires, and air pollution, volcanic ash poses a health risk, especially to children, the elderly, and people with cardiac or respiratory conditions, such as asthma, chronic bronchitis, and emphysema (USGS Fact Sheet 027-00).

Volcanic ash can contaminate water supplies; sufficient ash fall could clog water intake filter systems.

Cleanup, removal and disposal of volcanic ash from county roads, sidewalks, buildings, and from private residences and local businesses could have significant economic consequences.

### **Vulnerability Assessment**

Benton County is vulnerable to future volcanic ash fall from Cascade Range volcanic eruptions. The USGS has estimated that Benton County is in an area that has an annual probability of 0.01% to 0.02% (a chance of 1-2 in 10,000) of receiving 4 inches or more of tephra accumulation (Scott and others, 1995).

It is not possible at this time to describe the types and number of existing and future buildings, infrastructure, and critical facilities that are located within the volcanic hazard area, nor to estimate the potential dollar losses to vulnerable structures. Critical facilities within the county include water and wastewater treatment plants, water reservoirs and pipelines, electrical and sewer lines, roads, and bridges across the Yakima and Columbia rivers.

### **Risk Analysis**

A risk analysis has not been completed at this time.

## **5.4.3 Community Issues**

### **Current Conditions**

The Benton County Comprehensive Emergency Management Plan recommends that local planning include procedures for handling the special problems associated with ash fall, including damage to emergency vehicles and potential respiratory problems of emergency workers.

### **Ongoing Mitigation**

#### **Cascade Range Volcanic Activity Monitoring**

The USGS and Pacific Northwest Seismograph Network at the University of Washington conduct seismic monitoring of all Cascade volcanoes in Washington and Oregon. When unusual activity

is observed, scientists immediately notify government officials and the public. The US Forest Service serves as the primary dissemination agency for emergency information. As the activity changes, USGS scientists provide updated advisories and meet with local, state, and federal officials to discuss the hazards and appropriate levels of emergency response. The experience since 1980 at Mt. St. Helens and elsewhere indicates that monitoring is sufficient for scientists to detect the ascent of fresh magma that must take place before another large eruption. This information will enhance warnings and facilitate updated assessments of the hazard.

### **Warning Systems**

The most accurate warnings are those in which scientists indicate an eruption is probably only hours to days away based on significant changes in a volcano's earthquake activity, ground deformation, and gas emissions. Experience from around the world has shown that most eruptions are preceded by such changes over a period of days to weeks. A volcano may begin to show signs of unrest several months to a few years before an eruption. In these cases, however, a warning that specifies when it might erupt months to years ahead of time would be extremely rare. The strategy that the USGS-Cascade Volcano Observatory (CVO) uses to provide volcano warnings in the Cascade Range volcanoes in Washington and Oregon involves a series of alert levels that correspond generally to increasing levels of volcanic activity. As a volcano becomes increasingly active or as incoming data suggest that a given level of unrest is likely to lead to a significant eruption, the USGS-CVO declares a corresponding higher alert level. This alert level ranking thus offers the public and civil authorities a framework they can use to gauge and coordinate their response to a developing volcano emergency.

### **5.4.4 Mitigation Strategy**

A mitigation strategy has not been completed at this time.

### **5.4.5 Resources**

#### **State Resources**

##### **Washington State Military Department, Emergency Management Division**

Preparedness information for all types of disasters for family and community.

Programs Unit, Building 20, M/S: TA-20

Camp Murray, Washington 98430-5122

**Phone:** 800-562-6108

**Phone:** 253-512-7000

**Fax:** 253-512-7203

#### **Federal Resources**

##### **USGS-David A. Johnston Cascades Volcano Observatory (CVO)**

CVO provides accurate and timely information pertinent to assessment, warning, and mitigation of volcano hazards. It provides warnings during volcanic crises by monitoring volcanoes and interpreting results in the context of current hazard assessments. It also provides information for use in land-use management, emergency response plans, and public education.

**Contact:** CVO

**Address:** 1300 SE Cardinal Court, Vancouver, WA 98683

**Phone:** (360) 993-8900 **Fax:** (360) 993-8980

**Website:** [http://vulcan.wr.usgs.gov/CVO\\_Info/framework.html](http://vulcan.wr.usgs.gov/CVO_Info/framework.html) or <http://volcanoes.usgs.gov>

U.S. Geological Survey, Volcanic Ash – A “Hard Rain” of Abrasive Particles, Fact Sheet 027-00  
Online Version 1.0, <http://geopubs.wr.usgs.gov/fact-sheet/fs027-00/>

U.S. Geological Survey Volcano Hazards Program website:  
<http://volcanoes.usgs.gov/Hazards/What/hazards.html>

### **Additional Resources**

Hoblitt and others, 1987, *Cascade Range Volcanoes – Thickness vs. Distance of Select Cascade Range Tephra*s, U. S. Geological Survey Open-File Report 87-297.

Sarna-Wojcicki, A.M., S. Shipley, R.B. Waitt, Jr., D. Dzurisin, and S.H. Wood, 1981, *Areal Distribution, Thickness, Mass, Volume, and Grain Size of Air-Fall Ash From the Six Major Eruptions of 1980*, in Lipman, P.W. and D.R. Mullineaux, 1981, *The 1980 Eruptions of Mount St. Helens*, Washington, U.S. Geological Survey Professional Paper 1250, pp. 577-600.

Scott, W.E., R.M. Iverson, J.W. Vallance, and W. Hildreth, 1995, *Volcano Hazards in the Mount Adams Region*, Washington, U.S. Geological Survey Open-File Report 95-492.